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RESEARCH ARTICLE

Reducing Potentially Avoidable Complications in Patients with Chronic Diseases: The Prometheus Payment Approach

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Objective (or Study Question). To determine whether a new payment model can reduce current incidence of potentially avoidable complications (PACs) in patients with a chronic illness.
Data Sources/Study Setting. A claims database of 3.5 million commercially insured members under age 65.
Study Design. We analyzed the database using the Prometheus Payment model's analytical software for six chronic conditions to quantify total costs, proportion spent on PACs, and their variability across the United States. We conducted a literature review to determine the feasibility of reducing PACs. We estimated the financial impact on a prototypical practice if that practice received payments based on the Prometheus Payment model.
Principal Findings. We find that (1) PACs consume an average of 28.6 percent of costs for the six chronic conditions studied and vary significantly; (2) reducing PACs to the second decile level would save U.S.$116.7 million in this population; (3) current literature suggests that practices in certain settings could decrease PACs; and (4) using the Prometheus model could create a large potential incentive for a prototypical practice to reduce PACs.
Conclusions. By extrapolating these findings we conclude that costs might be reduced through payment reform efforts. A full extrapolation of these results, while speculative, suggests that total costs associated to the six chronic conditions studied could decrease by 3.8 percent.

Key Words. Payment reform, quality of care, efficiency of care

Costs of Potentially Avoidable Complications (PACs) are a Significant Driver of Total Chronic Care Cost

In 2009, U.S. health care consumed over U.S.$2.3 trillion or about 17.3 percent of the gross domestic product (GDP) (Truffer et al. 2010). Without

significant policy change, experts project that this level of spending will continue to grow more rapidly than the GDP. This trend might be justifiable if Americans were receiving care and experiencing outcomes commensurate with the cost. Per capita U.S. health care expenditure, however, is over twice as high as that of our nearest international competitor, and that expenditure includes an enormous and unacceptable amount of waste and defective care (Schoen et al. 2006). Further, when compared with other nations, the United States consistently ranks poorly in most health indicators.

Some have argued that a significant portion of the current spending is caused by "care defects"—errors, avoidable hospitalizations, and other process failures that cause patients to incur unnecessary services and harm. For example, a recent report by the Agency of Health Care Research and Quality (AHRQ) highlighted the fact that in 2006 hospital costs for potentially preventable hospitalizations were nearly U.S.$30.8 billion with $4.4 million out of a total of 39 million (11 percent) hospital-stays that could have been prevented; for Medicare beneficiaries one in five admissions were for a potentially preventable condition (Jiang et al. 2006). Another study by Jencks, Williams, and Coleman (2009) found that roughly 19.6 percent of Medicare patients incurred rehospitalizations within 30 days of discharge, and a recent paper in the *Annals of Internal Medicine* highlighted that close to 50,000 patients die each year from preventable infections in hospitals (Eber et al. 2010). Studies have shown, however, that care coordination can decrease ambulatory care-sensitive hospitalizations overall by 30 percent (Sochalski et al. 2009), with up to 50 percent of congestive heart failure (CHF) hospitalizations being avoidable (Braunstein et al. 2003). To start addressing these system failures, the Centers for Medicare and Medicaid Services (CMS) have removed payment adjustments that previously compensated hospitals for certain hospital-acquired conditions and "never events" (ECRI Institute 2008). Likewise, private insurers and Medicaid programs have adopted a variety of approaches to remove perverse financial incentives that effectively reward practices that lead to complications.

Given the ever-increasing number of patients with one or more chronic illnesses, the need for consistently high-quality, efficient chronic illness care is

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urgent (Bodenheimer 2008). To improve accountability in the delivery of chronic care, AHRQ has developed a list of prevention quality indicators to identify ambulatory care sensitive conditions (ACSCs) and measure rates of admissions that could have been potentially avoided with good outpatient care (Department of Health and Human Services, Agency for Healthcare Research and Quality 2008). Other groups have developed lists of potentially preventable complications. Recently, CMS has required that hospitals report a present on admission indicator to better track conditions and complications patients acquire after they are admitted to a hospital (Hughes 2006). While there is a general understanding of the nature of care failures in chronically ill patients (e.g., ambulatory care sensitive hospitalizations), there has not been a rigorous effort to quantify the amount spent on avoidable complications for chronically ill patients in an insured population and to estimate the savings that could be achieved by system-wide payment reform.

The Prometheus Payment model defines most care failures as PACs. The model creates a severity-adjusted Evidence-Informed Case Rate (ECR) to pay for typical and reliable care and provides an allowance for PACs, whether the complication actually occurs or not. This allowance should create a direct incentive for providers to reduce avoidable complications in order to avoid spending the allowance. The physicians could then turn the allowance or its remainder into a margin per patient (de Brantes, D'Andrea, and Rosenthal 2009). In this paper we (1) analyze the frequency and costs associated with PACs for six chronic conditions using a national commercially insured claims database and look at the variation in PAC costs across all states, ranking them into deciles; (2) estimate the financial impact in a prototypical practice paid under the Prometheus model if PACs were reduced to the second decile of observed PAC rates in the national database; and (3) determine the feasibility of reducing PACs in some clinical settings through a comprehensive review of the medical literature focused on the improvement of care quality for patients with chronic illnesses.

METHODS

Prometheus Payment has developed an analytical package to calculate ECRs for six common ACSCs (see http://www.prometheuspayment.org/playbook/chronic/eula-calculate-chronic-care-ECRs.htm): CHF, coronary artery disease (CAD), diabetes, hypertension, chronic obstructive pulmonary disorder (COPD), and asthma. This analytics package, *Chronic Care ECRs Analytical Package version 3.A*, is made available at no cost to academic and other

researchers and a simplified version is available to the general public. We analyzed the six ECRs using a national database of privately insured plan members covering the years 2005–2006. The database includes 3.5 million plan members under the age of 65—employees and dependents—who were the focus of the analysis. All professional, inpatient facility, outpatient facility, laboratory, radiology, ancillary, and pharmacy claims incurred and paid over 2 years were linked to each member (Table 1) in order to have complete longitudinal records. All these services and associated costs (allowed amounts plus member copayments) were included in the analysis.

ECRs for the six chronic conditions include all services relevant to the patient's condition and comorbidities for 12 consecutive months. The analytical package runs the prepared dataset through a series of filters that slot services into three categories: excluded services that were not related to the index condition, typical services that are considered routine in treatment of the index condition, and services related to PACs.

According to the Prometheus Payment model, for each chronic medical condition, except CAD, hospitalizations and emergency room visits (and associated professional services, ancillary services, and pharmacy costs) are deemed potentially avoidable if they are due to (1) acute exacerbations of the anchor condition, for example, diabetic emergency in a diabetic patient or acute pulmonary edema in a CHF patient (note that for patients with CAD, many hospitalizations are part of typical care and not considered PACs); (2) acute exacerbations of the patient's comorbid conditions such as a diabetic emergency or pneumonia hospitalization for a patient with heart failure (note that hospitalizations for a major surgical procedure such as joint replacement or cardiac bypass are not counted as PACs); and (3) patient safety failures such as major infections, deep vein thrombosis, adverse drug events, and other patient safety-related events.

Pharmacy claims for drugs used for the treatment of PACs (e.g., antibiotics, antiseptics, and thrombolytics) are included with the PACs. Of note, the model defaults the vast majority of medications to typical care because of the difficulty in associating pharmacy services with specific medical claims.

The analytical package calculates total costs for typical services and PACs for every condition (Table 2) and computes a severity-adjusted prospective price for 12 months of care for each patient identified in the database with a chronic condition. We used these ECR prices to estimate the total ECR-based revenue for a prototypical practice with 1,000 patients having a mix of chronic patients consistent with the mix in the studied database. We then compared that total revenue to current dollars paid to the practice under fee-for-service payments, using data from the database.

Table 1: Descriptive Statistics of Database Studied and Size of Population in Each Chronic Care ECR

Database	*< 65 (Commercial): 2 years—2005, 2006*		*Partial Geographic Distribution of Members with Claims (Not All States Are Listed)*	
Unique patients	3,566,417		Virginia	7.76%
Patient years	6,228,616		Texas	7.39%
Total claim volume	219,810,124		Florida	6.90%
Total claims (U.S.$ in millions)	32,972		Maryland	6.89%
Claim type	Claims	Millions U.S.$	California	4.16%
Inpatient facility	491,989	6,270	Pennsylvania	3.66%
Professional, outpatient facility, ancillary	143,066,813	17,045	Georgia	3.53%
Pharmacy	76,251,322	9,657	Alabama	3.24%
			Illinois	3.22%
Total	219,810,124	32,972	All other states	53.25%

Age Group	*Database*	*CHF*	*CAD*	*DIAB*	*HTN*	*COPD*	*Adult Asthma*	*PED Asthma*	
No. of Patients (prevalence)	3,566,417	14,818 (0.4%)	61,205 (1.7%)	172,103 (4.8%)	250,484 (7%)	78,991 (2.2%)	71,224 (2%)	Age Group	39,725 (1.1%)
< 18	18.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2–5	8.00%
18–29	9.2%	0.9%	0.4%	1.4%	1.3%	5.6%	7.8%	6–10	11.63%
30–39	8.4%	2.2%	1.7%	4.1%	6.2%	8.8%	8.0%	11–17	16.17%
40–49	14.4%	13.0%	11.9%	17.5%	23.4%	21.5%	16.9%		
50–59	18.7%	47.9%	50.6%	49.9%	48.6%	41.7%	23.2%		
60–64	5.9%	35.9%	35.4%	27.1%	20.5%	22.4%	8.3%		

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DIAB, diabetes; ECR, Evidence-Informed Case Rate; HTN, hypertension; PED, pediatric.

Source. Authors' analysis of the ECR models from data published by Prometheus Payment on http://www.prometheuspayment.org.

We studied regional variations in PAC rates for each of the six chronic conditions, by classifying the 50 states into deciles by PAC rates. We then calculated potential savings if PAC rates for states above the second decile were reduced to second decile levels. Similarly, we estimated the effect of the Prometheus Payment model in the prototypical practice if PAC rates were reduced to second decile levels.

We then performed a literature review to understand the percentage of PACs that might be avoided in clinical settings for the six chronic conditions studied, and to determine whether current observed rates of PACs could be reduced nationally. In particular, we looked for studies on variations in costs of care and their causes, as well as studies that demonstrated decrease in variations by reduction in avoidable complications.

RESULTS

Table 2 describes the distribution of costs for six chronic conditions in each of two categories: typical services and PACs. Approximately 30 cents of every dollar spent across these six conditions were consumed by PACs. The average percentage of costs for PACs relative to total costs for each ECR varied from 14.8 percent for hypertension to over 55 percent for CHF. By definition, hospitalizations and related professional services accounted for the majority of the PAC costs. Additionally, for most chronic conditions, about 20 percent of PACs were related to the index condition, 60 percent were due to comorbidities, and another 20 percent were due to patient safety failures.

Figure 1 illustrates the results of the regional variation analysis. For most of the conditions studied, there is a twofold difference in average PAC rates from states with lowest rates compared with those with the highest. These statewide PAC rates represent averages in each state, and within each state there is also significant variation. Table 3 shows the potential savings that could be achieved across all the six conditions for the 688,550 patients studied. Similar to the work performed by the Dartmouth Atlas, reducing PAC rates in states with rates above the second decile in each of the conditions to second decile levels would yield U.S.$116.7 million, or 3.8 percent of the U.S.$3.1 billion total costs. This amount extrapolates to U.S.$6.5 billion in total national savings when considering a privately insured base of 200 million Americans. Because we did not study Medicare- or Medicaid-insured Americans, we cannot estimate the potential savings in that population.

Table 2: Chronic Care ECR Summary Costs

	CHF	*COPD*	*DIAB*	*Asthma*	*HTN*	*CAD*	*Total*
No. of unique patients	14,818	78,991	172,103	110,949	250,484	61,205	688,550
Total costs (U.S.$)	213,753,887	372,358,813	1,166,748,148	333,895,371	594,707,771	420,280,915	3,101,744,905
Total typical (U.S.$)*	91,629,328	200,547,084	830,111,485	238,026,925	496,220,659	358,199,066	2,214,734,547
Typical stays (U.S.$)†						20,851,177	20,851,177
Typical outpatient facility (U.S.$)	13,492,696	27,075,818	78,964,169	21,306,728	31,701,128	62,898,624	235,439,163
Typical professional (U.S.$)‡	11,106,187	40,437,852	133,203,000	40,327,545	65,949,931	60,482,300	351,506,815
Typical pharmacy (U.S.$)§	67,030,446	133,033,414	617,944,316	176,392,652	398,569,600	213,966,964	1,606,937,392
Total PAC (U.S.$)¶	122,124,558	171,811,730	336,636,663	95,868,446	98,487,112	62,081,849	887,010,358
PAC stays (U.S.$)†	79,943,859	94,503,596	165,339,685	35,790,712	21,019,997	22,197,220	418,795,069
PAC outpatient facility (U.S.$)	16,891,378	36,719,012	72,558,909	29,049,966	26,962,015	15,095,885	197,277,165
PAC professional (U.S.$)‡	20,966,687	33,814,330	69,689,485	23,466,444	25,616,665	16,429,690	189,983,301
PAC pharmacy (U.S.$)§	4,322,635	6,774,792	29,048,584	7,561,324	24,888,436	8,359,054	80,954,825
% Dollars in typical*	42.87	53.86	71.15	71.29	83.44	85.23	71.40
% Dollars in PAC¶	57.13	46.14	28.85	28.71	16.56	14.77	28.60

*Typical services are services that are defined by Prometheus Payment as being relevant and appropriate in the treatment of patients with the studied condition.

†Stay costs only include the facility costs.

‡Professional services include services that are related to the stay as well as services not associated to a stay.

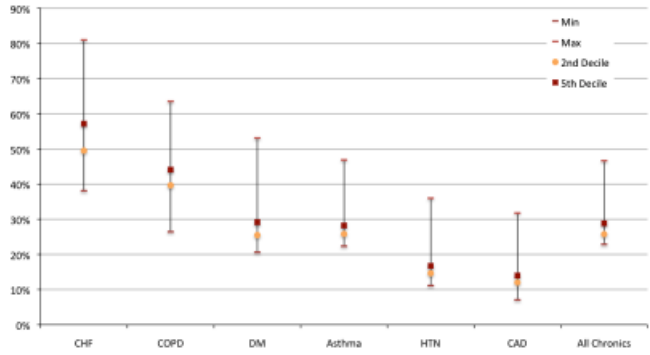
§Pharmacy costs are all costs reported in the database and related to the purchase of prescription drugs through pharmacies.

¶PAC services are services that are considered by Prometheus Payment as related to a potentially avoidable complication.

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DIAB, diabetes; ECR, Evidence-Informed Case Rate; HTN, hypertension; PAC, potentially avoidable complications.

Source. Authors' analysis of the ECR models from data published by Prometheus Payment on http://www.prometheuspayment.org.

Figure 1: Variation in Average Potentially Avoidable Complications Rates across States Ranked in Deciles



Source. Author's analysis of claims data using the Prometheus Payment ECRs

Table 4 summarizes our estimated results for a practice paid under the Prometheus Payment model compared with fee-for-service. The input variables are an estimate of the number of commercially insured patients with a chronic condition and their distribution in a practice. Two other input variables are the current observable PAC rates and target PAC rates. For each we used the actual observed in this study as reported in Table 1 and the targets from Table 3. The ECR costs, FFS costs, actual PAC occurrence, and PAC costs are derived from our analysis of the claims database. In this model, the practice's risk associated to the management of patients with asthma are significant, representing the relatively small additional margin that could be derived from an ECR payment for those patients, relative to the potential gain from reducing PAC rates from current levels. Overall, the practice's net gain would be close to U.S.$20,000. However, there is no estimate here of the expenses that would likely be incurred by the practice in order to improve the management of patients. Further, because extrapolations are inherently uncertain, a more in-depth evaluation of the Prometheus Payment model is crucial to assess its effects.

We used a systematic review of the literature to identify the percent of events stemming from care failures that might be avoided for the chronic conditions studied to determine whether PAC rates could be compressed to yield savings for payers and margin opportunities for providers under the Prometheus Payment model. We found that several studies have shown

Table 3: Savings Opportunity by Chronic Conditions When Reducing PAC Rates to Second Decile Values for States with PAC Rates above the Second Decile

For States with PAC Costs > Second Decile	*CHF*	*COPD*	*DM*	*Asthma*	*HTN*	*CAD*	*All Chronics*
Relevant costs (U.S.$ in millions)	202.8	337.8	1,011.1	281.1	515.5	398.1	2,746.4
PAC costs (U.S.$ in millions)	117.2	158.4	299.1	83.2	87.2	59.7	804.8
Average PAC (%)	58	47	30	30	17	15	29
Second decile PAC (%)	50	40	25	26	15	12	26
Savings opportunity (U.S.$ in millions)	16.8	24.5	41.4	10.7	11.7	11.8	116.7

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; HTN, hypertension; M, million; PAC, potentially avoidable complications.

Source. Authors' analysis of the ECR model.

Table 4: Results of Modeling the Net Effect of the Prometheus Payment Model on a Practice with 1,000 Chronic Care Patients

	HTN	*CAD*	*Asthma*	*Diabetes*	*CHF*	*COPD*	*Total*
Prevalence in database (%)	36.38	8.89	16.11	25	2.15	11.47	100
Number of patients (*n*)	364	89	161	250	22	115	1,000

	Average Pay/Patient (U.S.$)		*Per Patient "Bonus" Opportunity (A–B) (U.S.$)*	*Total "Bonus" Opportunity (C) (U.S.$)*	*PACs U.S.$ Incurred (D)*	*Net (C–D) (U.S.$)*
	ECR (A)	*FFS (B)*				
COPD	1,357	488	869	99,669	62,249	37,420
Diabetes	3,394	2,532	862	215,613	212,141	3,472
CHF	11,288	6,487	4,802	103,237	121,349	(U.S.$18,113)
Asthma	1,049	736	312	50,334	87,866	(U.S.$37,532)
CAD	1,856	1,230	626	55,696	19,805	35,891
HTN	1,290	1,102	188	68,434	70,376	(U.S.$1,943)
Overall	2,792	1,756		592,983	188,737	19,196

CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; ECR, Evidence-Informed Case Rate; HTN, hypertension; PAC, potentially avoidable complications.

Source. Author's analysis of the model presented in "Sustaining the Medical Home: How Prometheus Payment Can Revitalize Primary Care," Robert Wood Johnson Foundation Report, May 2009, http://www.rwjf.org/pr/product.jsp?id=42555, Technical Appendix C: ECR Chronic Care Estimator.

reductions in avoidable complications for patients with the chronic illnesses studied, albeit in very varied clinical settings.

For example, a study in Germany (Michalsen, König, and Thimme 1998) and a more recent one from Rich et al. (1995) showed that the number of hospital admissions and readmissions for heart failure could be reduced by more than 50 percent with appropriate patient management and interventions. In addition, AHRQ recently reported that for patients with chronic illnesses, CHF, and bacterial pneumonia were the two most common causes of potentially preventable hospitalizations and accounted for half of the avoidable hospitalization costs (Jiang et al. 2006). In their studies, Yuen (2004), Ahern (2007), and Kim (2007) demonstrated that 32–36 percent of all diabetes-related hospitalizations were related to short-term complications and uncontrolled diabetes and were considered avoidable using criteria from AHRQ. In addition, Kim estimated these avoidable hospitalizations led to an economic burden of U.S.$2.4–U.S.$2.8 billion. Furthermore, complications from diabetes could also be significantly reduced. Narayan et al. (2000) demonstrated that good glycemic and blood pressure control decreased the development of vascular disease by 25–35 percent and good lipid control decreased coronary events by 25–55 percent in diabetic patients. Similarly, a large study in the United Kingdom (U.K. Prospective Diabetes Study Group 1998) showed that tight blood pressure control in patients with type 2 diabetes led to a 44 percent decrease in incidence of stroke and a 50 percent decrease in major cardiovascular events. Narayan et al. also reported that regular eye exams could lead to a 60–70 percent decrease in serious vision loss, and a study by Aiello (2001) reported that intensive blood sugar control could lead to risk reductions ranging from 52 to 75 percent in development of severe retinopathy or the need for laser surgery. These studies also showed that pneumococcal vaccination could lead to a 32 percent decrease in pneumonia-related hospitalizations and a 64 percent decrease in development of respiratory conditions in diabetics. Finally, tight blood pressure control was also important in reducing the development of nephropathy (Ritz and Orth 1999), and Lavery, Wunderlich, and Tredwell (2005) demonstrated that good management of diabetic foot ulcers led to a 38 percent decrease in hospital admissions and a 47 percent decrease in foot amputations.

An age- and sex-adjusted population-attributable relative risk study by Li et al. (2005) demonstrated that 45 percent of strokes in hypertensive patients might be attributable to uncontrolled blood pressure ($\geq$ 140/90). These authors suggest that a substantial portion of first-time strokes in hypertensive patients may be preventable with better management of hypertension.

The principal reasons for admission for COPD or asthma are either exacerbation of the underlying condition or pneumonia (Merrill, Stranges, and Steiner 2008; Stranges, Merrill, and Steiner 2008). Aggressive pharmacological management of COPD and asthma has helped reduce hospitalizations or ED visits by 31–56 percent (Akazawa et al. 2008), and in their study Flores and Abrev (2005) reported that 15–54 percent of asthma-related hospitalizations in children could have been prevented through better education of the family, closer outpatient follow-up by PCPs, and avoiding known disease triggers.

Umscheid et al. (2008) used 2002 estimates of hospital-acquired infections (HAI) and determined the range of HAI risk reductions from U.S. studies (Ranji et al. 2007). They report that 18–82 percent of blood-stream infections, 46–55 percent of ventilator-associated pneumonia, 17–69 percent of urinary tract infections, and 26–54 percent of surgical site infections are preventable. Healy et al. (2002) analyzed complications in hospitalized surgical patients and reported that between 39 and 61 percent of major complications (wound infections, pneumonia, urinary tract infections, arrhythmias, respiratory failure, gastrointestinal complications, and deep vein thrombosis) and about an equal percent of minor complications could have been avoided. The National Pressure Ulcer Advisory Panel reported in 2001 that pressure ulcer prevention programs had reported 50 percent or greater reductions in facility-acquired pressure ulcers (Cuddigan, Berlowitz, and Ayello 2001). Similarly, appropriate prophylaxis could reduce the risk of venous thromboembolism by 45 percent in acutely ill medical patients (Leizorowicz et al. 2004), and a recent study found a 50 percent reduction in thromboembolic events with extended pharmacologic prophylaxis (Hull et al. 2007). Adequate evidence-based treatment protocols in preventing contrast nephropathy and adequate drug dosing have demonstrated a risk reduction between 52 and 90 percent in the incidence of acute renal failure in patients in the intensive care unit (Singri, Ahya, and Levin 2003). Additionally, a study of the use of a hospital electronic medical system with prompts for nursing care protocols demonstrated that infection rates dropped 88 percent, bedsores were reduced, and compliance to guidelines for care of patients on ventilator increased by 77 percent (Landro 2009).

Overall, our review of the literature suggests that current PAC rates might be reduced by about 50 percent for CHF and CAD, 40 percent for diabetes, 60 percent for COPD and asthma, and 75 percent for hypertension, as compared with the current rates. These potential reductions are significantly higher than what we used in our estimations of both (1) cost savings if providers in states with high average PAC rates were to decrease them to

second decile levels, and (2) our analysis of the prototypical practice. However, there is no evidence that the results achieved in these settings could be replicated widely across the U.S. delivery system.

DISCUSSION

There is ample evidence that the quality of care for patients with chronic conditions is poor. No research has systematically identified the costs associated with these kinds of practice patterns (McGlynn et al. 2003). The current cost of services that result from these types of care defects is significant. In our quantitative analysis, we found that conditions that are highly sensitive to the quality of ambulatory care (e.g., CHF, COPD, and asthma) resulted in high rates of PACs. We show that approximately 30 percent of total relevant costs for six chronic illnesses are expended on services that were labeled as PACs. Additionally, because most of the prescription medications were defaulted to typical care, it is possible that we are underestimating the PAC pharmacy costs and therefore the total PACs.

Our analysis had some data limitations. Our data do not contain patients whose care is paid for by Medicaid, Medicare, or self-pay patients. Further, all of the patients in this database enjoy a relatively high level of benefit coverage, in particular with respect to prescription drugs. As a result, the findings will not reflect a representative sample of patients in a community where there are high concentrations of Medicaid or self-pay patients. Additionally, the demographic distribution of the database is not nationally representative; however, the distribution of the patients does not seem to be skewed to regions with high hospital care intensity (Wennberg 2009).

Given the relative homogeneity of the population studied, the variation in average PAC rates by state cannot be explained away by differences in population mix. From our analysis, we calculated a total possible savings opportunity for those six conditions in the population studied of U.S.$117 million if regions with high PAC rates could decrease their rates to the second decile level for each chronic condition. Higher savings could be achieved if PAC rates were reduced to levels similar to the ones in the studies reviewed.

Our literature review supports a finding that proactive, structured care could reduce current failures in quality and also reduce costs associated with those failures. The six chronic medical conditions we studied here are ACSCs and the literature indicates that the majority of hospitalizations for these conditions could be avoided if the management of these patients was optimized.

However, the challenges to achieving reductions in care defects and associated savings are significant.

One obvious barrier is that the settings of many of the studies reviewed are not typical of the current fragmented U.S. delivery system. Another is that the current payment system does not encourage care coordination or the prudent use of services. Delivery system transformation and payment reforms are probably equally important in order for most practices to realize the kind of savings we describe here (Mechanic and Altman 2009).

Geisinger Health System's ProvenCare model is an example of such a combination of delivery and payment restructure in the acute care setting. In that system all services related to certain procedures, including preoperative, intraoperative, and postoperative care for 90 days after surgery, is included in a single price. By implementing best practices as part of their protocols they are holding the providers financially at risk for complications. Geisinger has reported a decline of 21 percent in the complication rate and a 44 percent decline in readmission rate for coronary bypass surgery (Davis and Stremikis 2009).

The Prometheus Payment model provides a similar potential option with bundled payments for procedural care, acute care, and chronic care. It introduces severity-adjusted case rates with allowances for PACs. By creating an allowance for PACs within each episode bundle, the Prometheus Payment model creates incentives for providers to reduce defects below that included in the allowance (de Brantes, D'Andrea, and Rosenthal 2009). In modeling the effects of the payment model in a prototypical practice, we find that reducing PACs from current average rates to observed second decile levels would create higher margins to the practice than achieved in fee-for-service. Higher PAC rate reductions seem plausible given the findings from our literature review and could yield significantly higher margins. The total calculated margin opportunity for the practice is close to U.S.$600,000 but is subject to avoidance of PACs and a likely significant internal investment toward clinical reengineering. The incentives in the Prometheus Payment appear to create the impetus for reduction in PACs; however, the ability for the practice to achieve these reductions, and the investment cost in human and capital resources it would need, remain unknown and subject to further study.

Efforts to introduce payment and delivery system reforms to improve chronic care management are underway in many payer and delivery system contexts, including two pilot sites testing the Prometheus model for chronic care. While these pilots should help shed some light on the ability and willingness of physicians to respond to a new set of incentives, further research will be needed to demonstrate which combination of care settings and incentives

helps health professionals most effectively minimize defects in chronic care and their related high costs.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

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